Novel organic materials and technological advances for photonics

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Preface

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In the continuity of the four previous E-MRS Symposia devoted to molecular materials, Symposium R held in June 2001 has put special emphasis on nanoscale structures, photoinduced molecular manipulation and biological applications of photonics, alongside the more traditional domains of light-emitting polymers and diodes, photovoltaic compounds and nonlinear optics in organic systems. This symposium has been attended by approximately 100 participants who have actively contributed to the 12 sessions composed of 49 oral papers and 55 poster presentations in a highly pluridisciplinary spirit. The continuity of this series of Molecular Photonics Symposia has greatly favored the emergence of a active scientific core-community in the field, with several collaborations connecting new participating groups after each symposium.

As one of the most promising issues of molecular photonics, the opening chapter of this special issue is devoted to biological applications such as 3D optical computing based of bacteriorhodopsin (University of Connecticut), nonlinear optical imaging of biological membranes (ESPCI, Paris) or fluorescence spectroscopy of glycopolymers (Academy of Sciences, Kiev).

Molecular nanostructure investigations have developed different approaches in the scope of this symposium, e.g. self-assembled materials based on siloxane chemistry, where layer-by-layer growth techniques are applied to the elaboration of nonlinear or charge-transporting and charge-blocking superlattices (Northwestern University), nanoaggregates of oligothiophenes (Eindhoven University) or light-emitting dendrimers (University of St Andrews and Linköping University). Periodic sub-micron structures made of luminescent conjugated polymers have been elaborated using laser ablation methods (Göttingen University) and characterized (University of St Andrews). Another approach is based on the fabrication of single-walled carbon nanotube–polymer composites and the subsequent elaboration of metal–semiconductor–metal diodes (Cambridge University, UK).

Photo-orientation and photomanipulation of isomerizable dyes are now being applied to various structures and applications, especially in liquid crystal polymers (Laval University) or chiral polymers for optical data storage based on photo-induced phase transitions (Darmstadt University). Light-induced structuration of azo dye polymers is used for the optimization and control of organic device emission properties (CEA-Saclay). Special emphasis is put on the demonstration of reversible photostructuration and its applications to waveguide gratings, holography and two-beam coupling (CSEM, Alpnach, Switzerland).

Besides the ongoing investigations on novel nonlinear crystals (University Paris VI) optical limiters based on fullerene-doped liquid crystals (Vavilov Institute, St Petersburg), biphenyl derivatives (ENS Paris), polydiacetylenes (Florence University) or chiral molecules (ENS Lyon), the elaboration of quadratic nonlinear polymeric photonic structures (ENS Cachan) results from the application of classical lithographic techniques to the 2D microscale structuration of electrically or optically electrooptic polymers.

Polymer-based photonic devices are now fastly developing towards various directions. In order to improve the efficiency of light-emitting microcavities, novel structures such as non-circular microdisks and microrings have been proposed and characterized (ENS Cachan and Yale University). At a material level, microcavities containing J-aggregate cyanine dyes have permitted the observation of anti-Stokes Raman resonant processes for the first time (Sheffield University). Polymer–oligomer blends have been used for the elaboration of OLEDs emitting in the blue range (Leuven University). The use of doped amorphous charge transport layers yields to low-voltage, very bright non-polymeric OLEDs, and demonstrates the great potential of controlled doping to design highly efficient and stable devices (Dresden University). In a more general perspective, novel materials for luminescence applications are currently investigated by various groups, e.g. oligothiophenes in oligophenylenevinylene films (Tübingen University), oxadiazoles (Potsdam University), *p*-phenylene-ethynylene (Strasbourg University). Technological issues such as polymer grating design and elaboration (Limoges University) and end-of-fiber polymer tips (Metz University) have also been reported as crucial steps towards the practical use of polymer-based photonic devices in optical systems and networks.

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This symposium reflects the fast evolution in the domain of Molecular Photonics, especially towards the elaboration and characterization of nanostructures, together with biological applications.

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